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PERFORMANCE TESTING OF SEALING TAPES FOR 81-mm MORTAR AMMUNITION FIBER CONTAINER

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This report details the performance testing conducted on four types of sealing tape systems for 81-mm mortar ammunition fiber container. The purpose of the test was to explore the possibility of applying only one sealing tape to replace the current double taping system. The test results concluded that both the MIL-T-43036, Type II and I tapes were the best alternate choices of replacements. This improvement could reduce the labor cost for the sealing operation by 50% and provide a substantial amount of savings on the taping materials.

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INTRODUCTION

The 81-mm mortar ammunition is unit-packaged in fiber tube containers. In order to resist moisture migration, for years the adjacent area between the fiber container cap and body was sealed using two layers of tapes. First, apply 1-1/4 turns of 1 in. wide sealing tape (MIL-T-43036, Type I, polyester reinforced) on the closure area. Then, two turns of 2 in. industrial grade of duct tape (PPP-T-60) is applied, overlapped over the MIL-T-43036 tape to complete the sealing. In 1995, the Packaging Division of the U.S. Army Armament Research, Development and Engineering Center (ARDEC) initiated a study program to determine the sealing performance of four taping systems. The purpose of this study was to explore the possibility of changing the double taping system by using only one tape that still retained the current sealing capability. If successful, this improvement could reduce the labor cost for the sealing operation by 50% and provide a substantial amount of savings on the taping materials. This report details this study program.

Test Procedures

The test sought to measure different sealing tapes' capabilities of preventing moisture penetration. A sealed fiber container represented a test sample. Each sample containing four desiccant bags were exposed to hot and humid environment in accordance with the aggravated temperature-humidity cycles of MIL-STD-810E (fig. 1).

Four types of taping methods were tested to compare their sealing performance:

- Current double tape system:
  - 1-1/4 turns of 1 in. tape, MIL-T-43036, Type I (polyester reinforced)
  - Two turns of 2 in. industrial duct tape, PPP-T-60
- Two turns of 2 in. tape, MIL-T-43036, Type I (polyester reinforced)
- Two turns of 2 in. tape, MIL-T-43036, Type II (non-reinforced)
- Two turns of 2 in. industrial waterproof duct tape, PPP-T-60

The test was conducted at the Environmental Test Laboratory located in Building 60, Picatinny Arsenal, New Jersey. The data collection took place between October 19, 1995 and November 6, 1995, over a period of 18 days. The weights of the empty containers, weights of desiccant bags, and packout weight of the containers were recorded before and after the test (table 1).

CONCLUSION

Although the test duration was not long enough for typical environmental testing, it did reveal reasonable engineering characteristic trends of these sealing tape materials.

It appeared that the MIL-T-43036, type II out performed the rest in the group as expected. At the end of the test, the average weight gain of the containers sealed with 2 in. MIL-T-43036, type II (non-reinforced) was only 0.011 lb compared to 0.012 lb with the double-tape system (inner-wrapped with 1 in. MIL-T-43036, Type I polyester reinforced tape and wrapped over with two turns of 2 in. industrial duct tape, PPP-T-60), 0.017 lb with 2 in. MIL-T-43036, Type I (polyester reinforced), and 0.02 lb with industrial waterproof duct tape, PPP-T-60.

Both the type I and II tapes of MIL-T-43036 maintained excellent adhesive capability throughout the test. At the end of the test, it was noticed that both the tapes were in excellent condition. The tape surface was smooth and the sealing with the surface of fiber containers was tight and inseparable. However, the performance of the industrial grade of duct tape (applied alone on the containers or as the outer layer of the double tape system) was disappointing. It became extremely wrinkled and easy to peel off. It was concluded that the industrial duct tape was not able to survive under the attack of hot and humid environment and it should not be used to seal the ammunition fiber container.

Based on the test results, the MIL-T-43036 type II tape (non-reinforced) was selected as the first choice of replacing the double tape system to seal the 81-mm ammunition fiber containers. Additionally, because the MIL-T-43036 type I tape (polyester reinforced) performed almost as good as the double tape system, it was chosen as an alternative sealing material for the application. These improvements were implemented into the 81-mm ammunition productions and are expected to provide a substantial cost savings for the current and future ammunition loading, assembling, and packing operations.

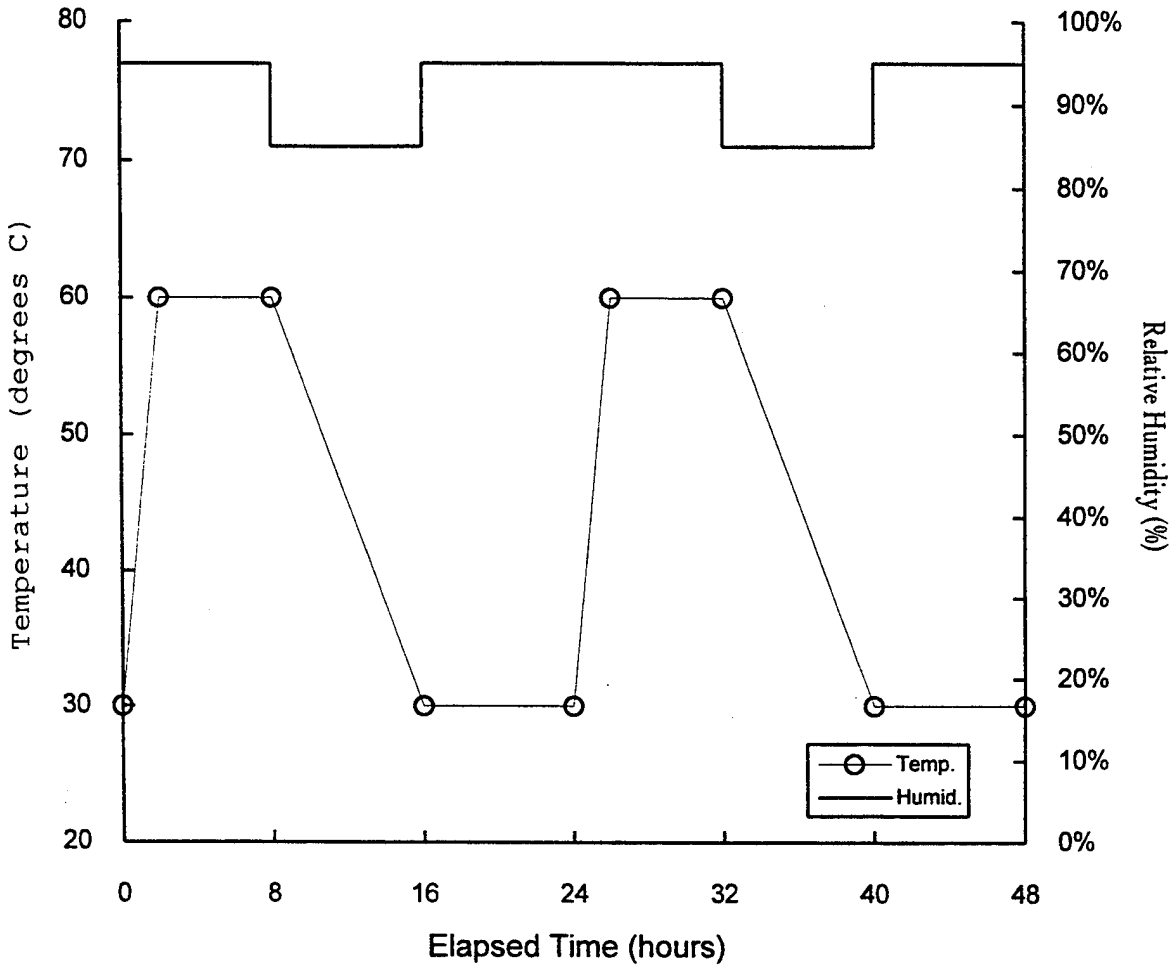

Figure 1
Two aggravated temperature-humidity cycles
(from MIL-STD-810E, figure 507.3.3)

Table 1
Weight changes of packout containers before and after test

	Container No.	Weight of Packout Container (lb)		Change	
		Before testing	After testing	lb	%
Double Tape System	1	2.67	2.68	0.01	0.375
	2	2.63	2.64	0.01	0.380
	3	2.67	2.69	0.02	0.749
	4	2.67	2.68	0.01	0.375
	5	2.74	2.75	0.01	0.365
	6	2.66	2.67	0.01	0.375
	Average			0.012	0.437
MIL-T-43036, Type I (Polyester reinforced)	1	2.65	2.67	0.02	0.755
	2	2.66	2.67	0.01	0.376
	3	2.68	2.70	0.02	0.746
	4	2.64	2.65	0.01	0.379
	5	2.69	2.71	0.02	0.744
	6	2.69	2.71	0.02	0.744
	Average			0.017	0.624
MIL-T-43036, Type II (Non-reinforced)	1	2.68	2.69	0.01	0.373
	2	2.67	2.68	0.01	0.375
	3	2.70	2.71	0.01	0.370
	4	2.63	2.645	0.015	0.570
	5	2.69	2.70	0.01	0.372
	6	2.71	2.72	0.01	0.369
	Average			0.011	0.405
PPP-T-60 Industrial Duct Tape	1	2.64	2.65	0.01	0.379
	2	2.71	2.73	0.02	0.738
	3	2.67	2.70	0.03	1.124
	4	2.68	2.70	0.02	0.746
	5	2.70	2.72	0.02	0.741
	6	2.66	2.68	0.02	0.752
	Average			0.02	0.747

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